

Claims

What is claimed is:

1. An apparatus for separating ions comprising:
 - a plurality of first electrode portions, each first electrode portion of the plurality of first electrode portions having a first length and an outer surface that is at least partially curved in a direction transverse to the first length;
 - a plurality of second electrode portions interleaved in a repeating sequence with the plurality of first electrode portions, each second electrode portion of the plurality of second electrode portions having a second length and an outer surface that is at least partially curved in a direction transverse to the second length, a space between the outer surface of a first electrode portion and the outer surface of an adjacent second electrode portion defining a portion of an analytical gap for separating ions; and,
 - at least an electrical controller for electrically coupling to at least one of the plurality of first electrode portions and the plurality of second electrode portions, for applying an asymmetric waveform voltage between the plurality of first electrode portions and the plurality of second electrode portions and for applying a direct current voltage between the plurality of first electrode portions and the plurality of second electrode portions so as to establish an electric field within the portion of the analytical gap, whereby ions propagating along a direction that is transverse to both the first length and the second length are separated in the portion of the analytical gap between the outer surface of the first electrode portion and the outer surface of the adjacent second electrode portion.
2. An apparatus according to claim 1, wherein the plurality of first electrode portions comprises a plurality of first electrode rods, each first electrode rod of the plurality of first electrode rods defining one first electrode portion of the plurality of first electrode portions.
3. An apparatus according to claim 2, wherein the plurality of second electrode portions comprises a plurality of second electrode rods, each second electrode rod of

the plurality of second electrode rods defining one second electrode portion of the plurality of second electrode portions.

4. An apparatus according to any of claims 1, 2, and 3, wherein one of the plurality of first electrode portions and the plurality of second electrode portions comprises a formed-electrode.
5. An apparatus according to claim 1, wherein the plurality of first electrode portions comprises a first formed-electrode and wherein the plurality of second electrode portions comprises a second formed-electrode, the second formed-electrode for being mounted relative to the first formed-electrode such that an approximately same spacing is maintained between a first electrode portion of the plurality of first electrode portions and each adjacent second electrode portion of the plurality of second electrode portions.
6. An apparatus according to claim 5, wherein at least one of the first formed-electrode and the second formed-electrode is generally an extended S-shaped electrode.
7. An apparatus according to claim 5, wherein the first formed-electrode comprises a first electrode assembly including a first plurality of rods and a first support, a first end of each rod of the first plurality of rods being mounted to the first support such that each rod is approximately parallel to and spaced-apart from every other rod of the first plurality of rods.
8. An apparatus according to claim 7, wherein the second formed-electrode comprises a second electrode assembly including a second plurality of rods and a second support, a first end of each rod of the second plurality of rods being mounted to the second support such that each rod is approximately parallel to and spaced-apart from every other rod of the second plurality of rods, the second electrode assembly being mounted relative to the first electrode assembly such that an approximately same spacing is maintained between each rod of the first plurality of rods and an adjacent rod of the second plurality of rods.

9. An apparatus according to claim 1, wherein each first electrode portion is approximately circular in a cross-section taken through a plane that is normal to the length of the first electrode portion and wherein each second electrode portion is approximately circular in a cross-section taken through a plane that is normal to the length of the second electrode portion.
10. An apparatus according to claim 1, wherein each first electrode portion is approximately elliptical in a cross-section taken through a plane that is normal to the length of the first electrode portion and wherein each second electrode portion is approximately elliptical in a cross-section taken through a plane that is normal to the length of the second electrode portion.
11. An apparatus for separating ions comprising:
- a housing including a first surface and a second surface spaced-apart from the first surface and facing the first surface, an inlet aperture defined within the first surface and an outlet aperture defined within the second surface;
 - a plurality of rod-shaped electrodes disposed between the first surface and the second surface such that each rod-shaped electrode of the plurality of rod-shaped electrodes is approximately parallel to both the first surface and the second surface, each rod-shaped electrode of the plurality of rod-shaped electrodes having a length and being spaced-apart from an adjacent rod-shaped electrode, so as to define an analytical gap extending between the inlet aperture and the outlet aperture for allowing ions to propagate therebetween along a direction of travel that is transverse to the length; and,
 - at least an electrical controller for electrically coupling to at least some rod-shaped electrodes of the plurality of rod-shaped electrodes, for establishing an electric field within the analytical gap by the application of an asymmetric waveform voltage to the at least some rod-shaped electrodes of the plurality of rod-shaped electrodes and by the application of a direct current voltage to one of the at least some rod-shaped electrodes of the plurality of rod-shaped electrodes and other rod-shaped electrodes of the plurality of rod-shaped electrodes.

12. An apparatus according to claim 11, wherein the rod-shaped electrodes of the plurality of rod-shaped electrodes are arranged such that each rod-shaped electrode to which the asymmetric waveform voltage is applied has as its nearest neighbor a rod-shaped electrode to which only the direct current voltage is applied.
13. An apparatus according to any one of claims 11 and 12, wherein the inlet aperture is adapted for providing a flow of a gas into the housing, through the analytical gap and out of the outlet aperture, the flow of gas for transporting ions along the direction of travel that is transverse to the length.
14. An apparatus according to any one of claims 11, 12 and 13, wherein the first surface includes a plurality of inlet apertures for supporting introduction of ions into the analytical gap at a plurality of different locations along the first surface, each different location corresponding to a location of one of the plurality of inlet apertures, the plurality of inlet apertures including the inlet aperture defined within the first surface.